Upper Grande Ronde River Spring Chinook Population

The Upper Grande Ronde River Chinook population (Figure 1) is part of the Snake River Spring/Summer Chinook ESU which has five major population groupings (MPGs), including: Lower Snake River, Grande Ronde / Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River group. The ESU contains spring, spring-summer, and summer run Chinook. The Upper Grande Ronde population is a spring run and is one of seven extant populations in the Grande Ronde / Imnaha MPG.

The ICTRT classified the Upper Grande Ronde population as a "large" population (Table 1) based on historical habitat potential (ICTRT 2005). A Chinook population classified as large has a mean minimum abundance threshold criteria of 1,000 naturally-produced spawners with a sufficient intrinsic productivity to achieve a 5% (greater than 1.45 recruits per spawner at the threshold abundance level) or less risk of extinction over a 100-year timeframe.

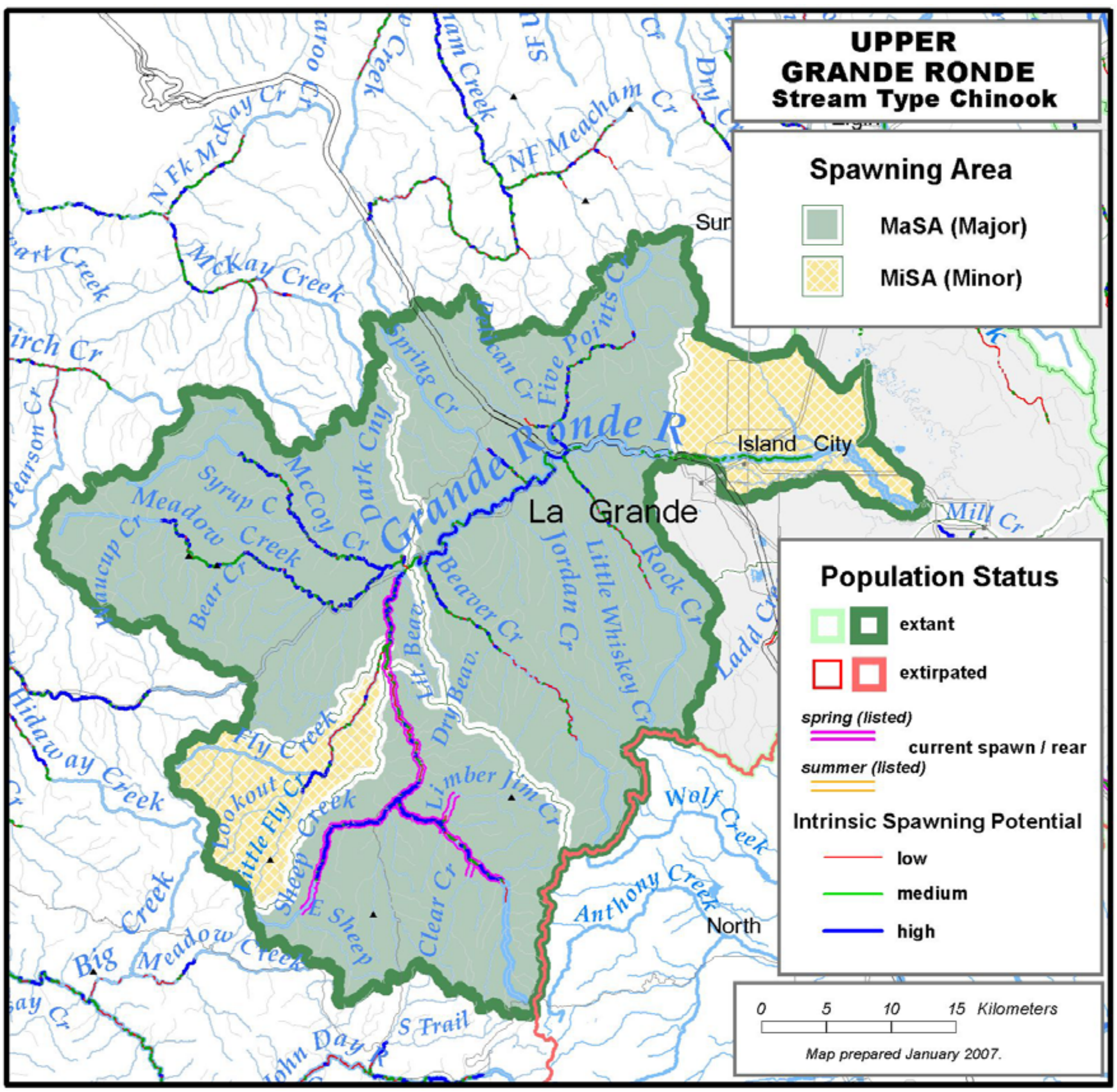

Figure 1. Upper Grande Ronde River Spring Chinook Salmon population major (MaSA) and minor (MiSA) spawning areas.

Table 1. Upper Grande Ronde River Spring Chinook Salmon population basin statistics and intrinsic potential analysis summary.

Drainage Area (km2)	1,942
Stream lengths km[a] (total)	952
Stream lengths km[a] (below natural barriers)	920
Branched stream area weighted by intrinsic potential (km2)	0.773
Branched stream area km2 (weighted and temp. limited)[b]	0.773
Total stream area weighted by intrinsic potential (km2)	0.893
Total stream area weighted by intrinsic potential (km2) temp limited[b]	0.893
Size / Complexity category	Large / "B" (dendritic)
Number of Major Spawning Areas	3
Number of Minor Spawning Areas	2

[a]All stream segments greater than or equal to 3.8m bankfull width were included
[b]Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22ºC.

Current Abundance and Productivity

Current (1953 to 2003) abundance (number of adult spawners in natural production areas) has ranged from 3 in 1989 to 855 in 1969 (Figure 2). Abundance estimates varied through time. Prior to 1997 spawner abundance estimates are based on expanding redd counts observed during spawning ground surveys conducted annually since 1953. From 1997 to present, spawner abundance was based on weir counts, mark-recapture estimates and redd counts, with adjustments pre-spawning mortality.

In the Grande Ronde River, index surveys were conducted as early as 1955. However, we have considerable uncertainty in estimates prior to 1964 because of incomplete records of the extent of stream miles surveyed. The date of index surveys during the 1964-1996 period varied, ranging from 1 September to 28 September. Extensive surveys began in 1986 below the historic index sections. From 1986-1994 the extensive section survey was conducted at the same time as the index area. After 1994, the portion of the index areas in Vey Meadows was either not surveyed or surveyed only during a supplemental survey. In addition, beginning in 1997, the portion of Chinook salmon using the extensive area may have been influenced by the construction of a weir below the index area. For these reasons, only the 1986 through 1994 data was used to develop a spatial expansion factor to apply to years when extensive surveys were not conducted. The spatial expansion factor was calculated as the proportion of redds in the index area to total redds in both index and extensive areas.

Supplemental surveys were conducted from 1986 to present on either the entire index area or a consistent portion of it and were used to develop a temporal expansion of redd counts for years prior to 1987. Because the start date of index surveys from 1964 through 1986 varied, an unbiased expansion factor was needed to account for variation in start dates in these years. To develop an unbiased expansion, we used the 1986-2005 data to calculate the proportion of redds observed in the index area on the index date to total redds in the same area after supplemental surveys for each year data was available. These proportions were plotted against survey date (day of year) and a regression line fitted. We then used this regression to temporally expand redd counts in years when supplemental surveys were not conducted. Some of the 1964-1986 survey dates were beyond the dates used to develop the regression and we did not want to extrapolate our regression to estimate redds. For this reason, we applied the regression to expand redd counts if the index date was prior or equal to 03 September (1965, 1977, 1981, and 1986).

We did not attempt to temporally expand redd counts for years when surveys were conducted after this date because little additional spawning occurs. From 1986 to 1996, if supplemental surveys were done on only a portion of the index section, year specific temporal expansions were developed to expand redd counts for the portion of index section surveyed only once. Total redds were estimated by applying the spatial and temporal expansion factors where applicable. We estimated total spawners each year by multiplying total redds by an estimated 3.2 spawners per redd, derived from spawner per redd studies on the Imnaha River.

From 1997 to present, total escapement was estimated based on weir counts of jacks and adults, mark-recapture estimates of adults, and redd counts. Escapement above the weir was the sum of the known number of fish captured and subsequently passed above the weir and an estimated number of untrapped fish. The number of untrapped adults above the weir was determined from mark-recapture estimates of adults. Weir efficiency was determined from the ratio of trapped adults to the estimated total adults above the weir and applied to the number of trapped jacks to provide an estimate of total jacks above the weir. Escapement to the weir was the sum of the total trapped and estimated untrapped fish. The estimated escapement below the weir was determined by first calculating a fish per redd estimate above the weir and applying this ratio to the observed number of redds below the weir. Redd counts were expanded to account for any areas not surveyed. Spawner escapement was the sum of the estimated escapement above and below the weir. Total spawners were estimated by multiplying an estimated pre-spawn survival rate to the estimated spawner escapement. Pre-spawn survival was derived from female carcass information collected on spawning ground surveys and was the ratio of spawned out females to total observed. Females carcasses with greater 50% of eggs retained were considered pre-spawn mortalities.

The estimated spawners includes natural-origin and hatchery-origin fish. Prior to 1986 the hatchery fraction is 0%. From 1986-1994 the fraction of total spawners of hatchery origin was calculated based on results of discriminate scale analyses and observed CWT-fin marked fish from carcass recoveries. The estimated hatchery fraction from 1995-1997 was based on carcass recoveries during spawning ground surveys that were >50% spawned. Hatchery origin was determined by the presence of coded-wire tag. From 1998 to present, the hatchery fraction of spawners was based on total spawners estimates and the proportion of hatchery origin determined by the presence of an adipose fin clip observed at the weir.

Natural-origin recruits are apportioned into brood year cohorts to estimate adult recruits. Prior to 1997, age structure of natural-origin spawners on spawning grounds was determined from carcass recoveries when sufficient sample sizes were available (n>20). Spawners of natural origin were determined by the absence of a coded-wire tag. Only fish >50% spawned were used in estimates. Age was determined by scale analysis if available or length-age relationship. From 1997-2005, age structure of natural-origin spawners was determined from age specific escapement estimates. Age structure was determined from fish trapped at the weir by scales and length-age relationships.

Recent year natural spawners include returns originating from naturally spawning parents, and hatchery fish released into the upper Grande Ronde River from Lookingglass Fish Hatchery or strays from releases elsewhere in the basin. Prior to 1998 hatchery fish in the upper Grande Ronde River were of Carson or Rapid River hatchery stock origin. From 1998-2001 no hatchery fish were observed in the Upper Grande Ronde population. The hatchery program was reinitiated with local Grande Ronde River broodstock and the first returns to the population began in 2002. Natural-origin spawners have comprised an average of 83% since 1955, while the most recent 10-year average is 77% (Table 2).

Abundance in recent years has been moderately variable, the most recent 10-year geomean number of adult natural-origin spawners was 38 (Table 2). During the period 1979-1998, returns per spawner for Chinook in Upper Grande Ronde ranged from 0.02 (1990) to 2.16 (1998). The most recent 20 year (1981-2000) SAR adjusted and delimited (at 75% of the 1,000 threshold abundance level) geometric mean of returns per spawner was 0.33 (Table 2).

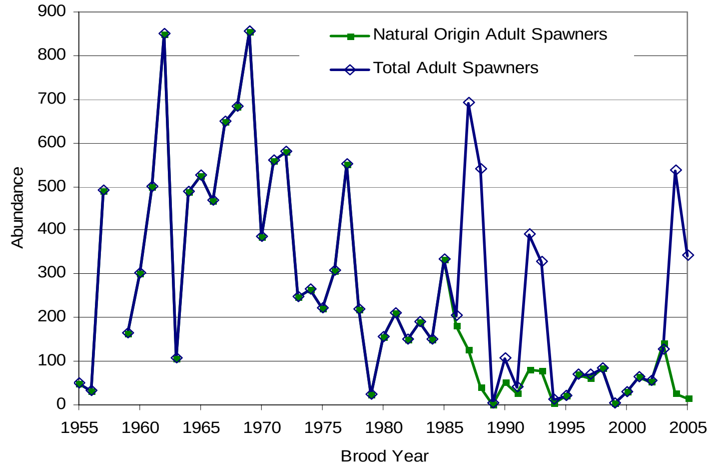

Figure 2. Upper Grande Ronde River Spring Chinook Salmon population abundance stimates (1955-2005).

Table 2. Upper Grande Ronde River Spring Chinook Salmon population abundance and productivity estimates.

10-year geomean natural abundance (adults)	38
20-year return/spawner productivity	0.32
20-year return/spawner productivity, SAR adj. and delimited[a]	0.42
20-year Bev-Holt fit productivity, SAR adjusted	0.67
20-year Lambda productivity estimate	n/a
Average proportion natural origin spawners (recent 10 years)	0.77
Reproductive success adj. for hatchery origin spawners	n/a

[a]Delimited productivity for this population excludes spawner/return pairs associated with parent escapements greater than 209. This is the greatest spawning escapement that has a return per spawner value (adjusted for marine survival) greater than 0.95. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to the Viability Curve

- Abundance: 10-year geomean natural origin spawners
- Productivity: 20-year geomean R/S (adjusted for marine survival and delimited at 209 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Upper Grande Ronde population is at **HIGH** risk based on current abundance and productivity.

  The point estimate resides below the 25% risk curve (Figure 3).

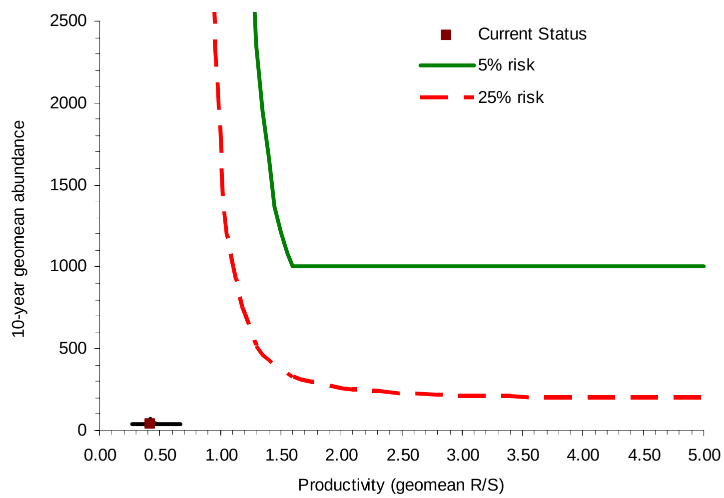

Figure 3. Upper Grande Ronde River Spring Chinook Salmon population abundance and productivity compared to the viability curve for this ESU. The point estimate includes a 1 SE ellipse and 95% CI (1.81 X SE abundance line, and 1.73 X SE productivity line).

Spatial Structure and Diversity

The ICTRT has identified three major spawning area (MaSAs) and two minor spawning areas (MiSAs) within the Upper Grande Ronde Spring Chinook population (Figure 4). Current spawning distribution is reduced substantially from historic. Currently spawning only occurs consistently in the upper Grande Ronde River mainstem from the confluence with Meadow Creek upstream to East Fork Grande Ronde River. Spawning distribution is reduced due to absence of spawning in the Grande Ronde River downstream of Meadow Creek and in numerous tributaries, such as Meadow Creek, that historically supported Chinook. Hatchery fish have comprised a significant proportion of natural spawners in most years since the mid 1980s.

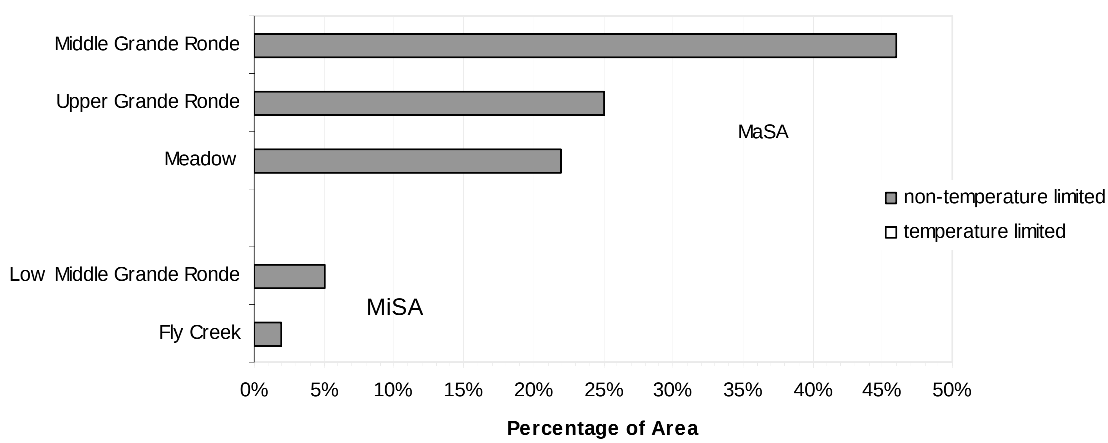

Figure 4. Upper Grande Ronde River Spring Chinook Salmon population distribution of intrinsic potential habitat across major and minor spawning areas.

Factors and Metrics

<u>A.1.a. Number and spatial arrangement of spawning areas.</u>

The Upper Grande Ronde population has three MaSAs and two MiSAs (Figure 4) identified based on intrinsic potential analyses. Currently spawner distribution is much reduced from historic and only the lower portion of the Meadow MaSA is utilized with spawning occurring only in the mainstem area of this MaSA.

The Upper Grande Ronde River MaSA is currently occupied with use in both the upper and lower portions. We have rated this metric as **moderate risk** because the quantity of habitat currently in the occupied MaSA, along with the utilized upper portion of the Meadow MaSA, equates to the minimum required for three MaSAs.

A.l.b. Spatial extent or range of population.

Loss of occupancy in the lower Grande Ronde MaSA, Meadow MaSA, and the two MiSAs places the population at **high risk** for this metric (Figure 5). This high risk rating results because less than 50% of the historical MaSAs are occupied. The reduced current spawner distribution results in a linear “A” type population distribution.

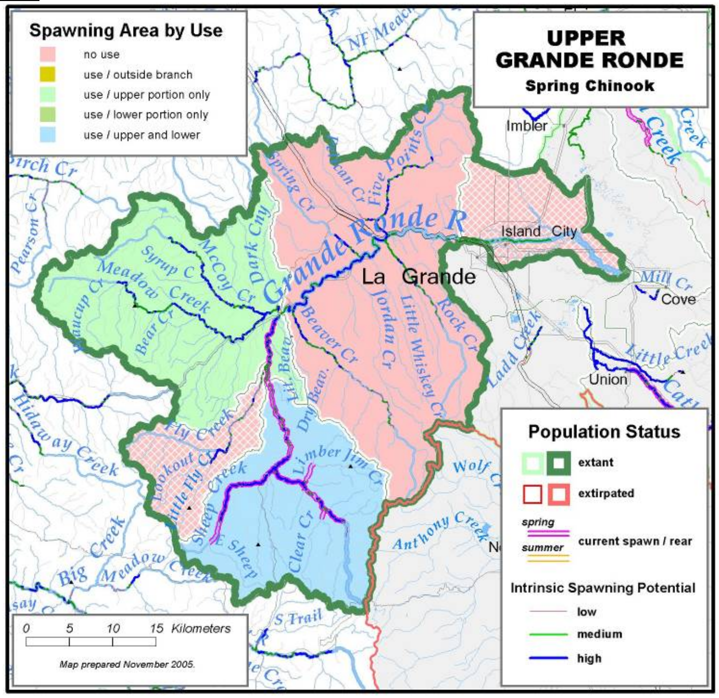

Figure 5. Upper Grande Ronde River Spring Chinook Salmon population current spawning distribution and spawning area occupancy designations..

A.1.c. Increase or decrease in gaps or continuities between spawning areas.

The reduced distribution results in a substantial increase in gaps between the MaSAs and MiSAs within the population. In addition, loss of occupancy in the lowest distributed MaSAs and MiSAs results in a substantial increase in the gap between the Upper Grande Ronde population and the nearest neighbor population in Catherine Creek. The magnitude of gap change results in a **high risk** rating for this population.

B.1.a. Major life history strategies.

There are currently two primary life history pathways utilized for the freshwater juvenile life stages: fish rear from emergent fry to smolt in the upper reaches of the Grande Ronde River in the spawning areas or fish leave the upper reaches in the fall as parr and overwinter in the Grande Ronde Valley prior to beginning seaward migration in the spring. We have no direct observational data to assess lost life history diversity. However, we use EDT and habitat change information to infer lost opportunities for life history expression. We hypothesize that there have been reductions in the variation of juvenile pathways such as fry and parr summer movement from the spawning areas into the low gradient reaches in the Grande Ronde Valley. In addition adult migration and spawn timing has likely shifted and has reduced variability relative to historic patterns as a result of flow and temperature changes. We have rated this metric as **moderate risk** because there has likely been significant reduction in variability of life history pathways with substantial change in relative distribution.

B.1.b. Phenotypic variation.

Data are not available to assess the degree to which phenotypic traits have been altered or lost. Therefore, we used habitat changes and EDT results to infer the potential for phenotypic changes. Flow and temperature changes have reduced the potential for variation in juvenile migration timing and adult migration timing within the Grande Ronde Basin and in the mainstem Columbia and Snake rivers. Lower flows and warmer water temperatures have likely truncated the adult migration timing and reduced opportunity for fry and summer parr downstream migration. The combination of mainstem and tributary affects has likely resulted in change in mean and variability of two or more traits. We have rated this metric as **moderate risk**.

B.1.c. Genetic variation.

The Upper Grande Ronde River population has been rated as **moderate risk** for genetic variation. The genetics information indicates a moderate level of inter-annual variation and significant divergence from other Grande Ronde populations in most years. The Grande Ronde samples are not significantly different from many hatchery samples in some years.

B.2.a. Spawner composition.

(1) *Out-of-ESU spawners*. From the early 1980's until the mid 1990's Carson and Rapid River stock hatchery fish were released into the upper Grande Ronde River as part of the LSRCP program. The use of these stocks has been discontinued. For our assessment we consider both of these hatchery stocks as out-of-ESU origin. For the period 1991–2005 (three generations) out-of-ESU hatchery fish comprised an average of 18.3% of the naturally spawning fish in the upper Grande Ronde River. This level results in a **high risk** rating for this metric.

(2) *Out-of-MPG spawners from within the ESU*. We have not recovered any out-of-MPG within ESU strays in the upper Grande Ronde River. Therefore, the rating for this metric is **very low risk**.

(3) *Out of population within MPG spawners*. We have not recovered any strays from the Lostine River or Upper Grande Ronde River hatchery programs. Therefore, the rating for this metric is **very low risk**.

(4) *Within-population hatchery spawners.* Adults from the local Catherine Creek hatchery broodstock supplementation program began returning in 2002. The mean percent within-population hatchery fraction for the period 2002–2005 was 43.6%. We have characterized this hatchery program as "best management practices." Given this level of hatchery fraction the criteria is rated at **moderate risk** for this metric.

The overall rating for spawner composition is **high risk**.

B.3.a. Distribution of population across habitat types.

The intrinsic distribution of the Upper Grande Ronde population encompassed three ecoregions (Figure 6) of which only one ecoregion accounted for more than 10% of the ecoregion distribution (Table 3). There is 92.2% of the historic intrinsic distribution in the Maritime Influence Zone ecoregion. Even though there has been a significant reduction in spawner distribution there has been no significant change in ecoregion distribution. We have rated this metric as **low risk**.

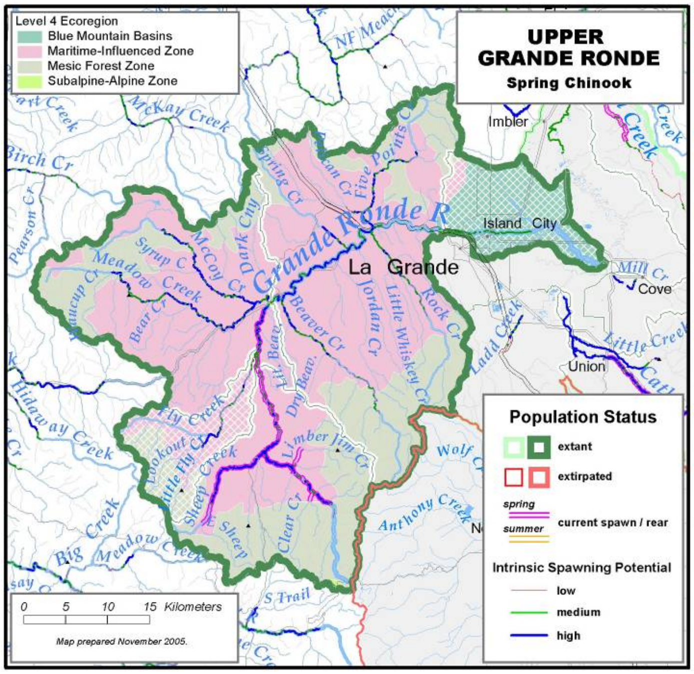

Figure 6. Upper Grande Ronde River Spring Chinook Salmon population spawning distribution across EPA level 4 ecoregions.

Table 3. Upper Grande Ronde River Spring Chinook Salmon population proportion of current spawning areas across EPA level 4 ecoregions.

Ecoregion	% of historical branch spawning area in this ecoregion (non-temperature limited)	% of historical branch spawning area in this ecoregion (temperature limited)	% of currently occupied spawning area in this ecoregion (non-temperature limited)
Blue Mountain Basins	5.4	5.4	0.0
Maritime-Influenced Zone	92.2	92.2	98.0
Mesic Forest Zone	2.3	2.3	2.0

B.4.a. Selective change in natural processes or selective impacts.

Hydropower system: The hydropower system and associated reservoirs likely pose some selective mortality on juvenile migrants by altering migration timing, duration, time specific survival, and ocean entrance timing. We do not have quantitative data to assess if the mortality is selective on 25% or more of the affected individuals; however, we hypothesize that the mortality is less than 25% consistently for any population component. We have rated this metric as **low risk** because multiple life stages are affected.

Harvest: Current harvest regulations are very restrictive and allow for only a small proportion (5-10%) of Snake River spring-summer Chinook to be harvested annually. The methods of harvest are generally nonselective for adult sized fish. We have rated this metric as **low risk**.

Hatcheries: A hatchery supplementation program is operated within the Upper Grande Ronde population and includes operation of a weir for broodstock collection and passage of adults to the spawning grounds. The hatchery weir is managed such that little or no selection (run-timing, age, etc.) occurs in most years. We have rated this metric as **low risk**.

Habitat: Significant changes in many habitat attributes have occurred in the upper Grande Ronde River relative to historic conditions. Flow and temperature patterns are altered with much reduced flow in summer and increased temperatures. These factors have significantly influenced adult and juvenile migration opportunity as well as availability of adult holding habitat. Selective pressures against fry and summer downstream movement and late adult migration are likely significant and affect 25% or greater of the individuals that historically expressed these traits. We have rated this metric as **moderate risk** because multiple life stages are influenced.

The overall rating for selective change is **moderate risk**.

Spatial Structure and Diversity Summary

The combined Spatial Structure/Diversity rating is high risk for the Upper Grande Ronde River population (Table 4). There are a substantial number of criteria that are rated at moderate or high risk. The rating for Goal A, “allowing natural rates and levels of spatially mediated processes,” was high with metrics for number and arrangement of spawning areas, range of population, and changes in gaps and continuity rated as high risk.

The rating for Goal B, “maintaining natural levels of variation,” was moderate risk. This Goal B rating was driven by impairment for all of the Goal B metrics: loss in life history strategies; reduced phenotypic variation; genetic variation; past affects of out-of-ESU hatchery fish and recent high fractions of local origin hatchery fish; and, selective mortality effects of the tributary habitat. We expect the risk ratings for genetic variation and out-of-ESU hatchery strays to improve over time because of the hatchery broodstock management changes that have occurred.

Table 4. Upper Grande Ronde River Spring Chinook Salmon population spatial structre and diversity risk rating summary.

Metric	Risk Assessment Scores				
	Metric	Factor	Mechanism	Goal	Population
A.1.a	M (0)	M (0)	Mean = (-.67) High Risk	High (-1)	High Risk
A.1.b	H (-1)	H (-1)			
A.1.c	H (-1)	H (-1)			
B.1.a	M (0)	M (0)	Moderate (0)	Mean = 0 Moderate Risk	
B.1.b	M (0)	M (0)			
B.1.c	M (0)	M (0)			
B.2.a(1)	H (-1)	H (-1)	High Risk (-1)		
B.2.a(2)	VL (2)				
B.2.a(3)	VL (2)				
B.2.a(4)	M (0)				
B.3.a	L (1)	L (1)	L (1)		
B.4.a	M (0)	M (0)	M (0)		

Overall Viability Rating:

The overall viability rating for the Upper Grande Ronde population does not meet viability criteria and is considered at the highest risk possible (Figure 6). The 10-year geomean natural origin abundance is 40 fish, which is only 4.0 % of the population threshold of 1,000. The point estimate of productivity 0.32 (Table 6) with the lower end of the 95% CI near zero. This productivity is one of the lowest of any population in the Snake River Spring/Summer Chinook ESU. The spatial structure/diversity rating is high risk as a result of numerous moderate and high risk ratings. In particular the dramatic reduction in spawner distribution contributes substantially to the high risk rating.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	**HV**	**HV**	**V**	M*
	Low (1-5%)	**V**	**V**	**V**	M*
	Moderate (6 – 25%)	M*	M*	M*	
	High (>25%)				**Grande Ronde**

Figure 7. Upper Grande Ronde River Spring Chinook Salmon population risk ratings integrated across the four viable salmonid population (VSP) metrics. ***Viability Key: HV – Highly Viable; V – Viable; M – Candidate for Maintained; Shaded cells-- not meeting viability criteria (darkest cells are at greatest risk).***

Upper Grande Ronde River Spring Chinook – Data Summary

Data type: Redd count expansions
SAR: Averaged Williams/CSS series

Table 5. Upper Grande Ronde River Spring Chinook Salmon population abundance and productivity data used for curve fits and R/S analysis. Bolded values were used in estimating the current productivity (Table 6).

Brood Year	Adult Spnrs	%Wild	Nat. Adults	Nat. Rtns	R/S	SAR Adj. Factor	Adj. Rtns	Adj. R/S
1981	**208**	**1.000**	**208**	**316**	**1.52**	**0.63**	**199**	**0.95**
1982	**149**	**1.000**	**149**	**119**	**0.80**	**0.51**	**61**	**0.41**
1983	**190**	**1.000**	**190**	**144**	**0.76**	**0.58**	**83**	**0.44**
1984	**150**	**1.000**	**150**	**18**	**0.12**	**1.65**	**30**	**0.20**
1985	332	1.000	332	13	0.04	1.57	21	0.06
1986	**205**	**0.857**	**180**	**52**	**0.26**	**1.41**	**74**	**0.36**
1987	692	0.176	125	20	0.03	1.83	37	0.05
1988	539	0.077	41	144	0.27	0.75	108	0.20
1989	3							
1990	**105**	**0.500**	**53**	**2**	**0.02**	**4.65**	**8**	**0.07**
1991	**39**	**0.600**	**26**	**21**	**0.54**	**3.01**	**64**	**1.62**
1992	390	0.206	81	81	0.21	1.65	134	0.34
1993	327	0.229	76	113	0.35	1.61	182	0.56
1994	**13**	**0.331**	**4**	**17**	**1.39**	**1.04**	**18**	**1.45**
1995	**20**	**1.000**	**20**	**4**	**0.18**	**0.60**	**2**	**0.11**
1996	**68**	**1.000**	**68**	**33**	**0.48**	**0.54**	**18**	**0.26**
1997	**68**	**0.900**	**61**	**69**	**1.02**	**0.30**	**21**	**0.30**
1998	**83**	**1.000**	**83**	**180**	**2.16**	**0.30**	**53**	**0.64**
1999	4							
2000	**30**	**1.000**	**30**	**31**	**1.05**	**1.00**	**31**	**1.05**
2001	64	1.000	64					
2002	54	0.952	51					
2003	126	0.800	140					
2004	535	0.049	26					
2005	341	0.043	15					

Table 6. Upper Grande Ronde River Spring Chinook Salmon population geometric mean abundance and productivity estimates (values used for current productivity and abundance are shown in boxes).

	R/S measures						Lambda measures		Abundance
	Not adjusted			SAR adjusted			Not adjusted		Nat. origin
delimited	median	209 spawners	75% threshold	median	209 spawners	75% threshold	1989-2000	1981-2000	geomean
Point Est.	0.47	0.48	0.32	0.42	$\boxed{0.42}$	$\boxed{0.32}$	n/a	n/a	$\boxed{38}$
Std. Err.	0.56	0.37	0.33	0.41	0.26	0.24			0.33
count	8	13	18	8	13	18			10

Table 7. Upper Grande Ronde River Spring Chinook Salmon population stock-recruitment curve fit parameter estimates. Biologically unrealistic or highly uncertain values are highlighted in grey.

	Not adjusted for SAR							Adjusted for SAR						
SR Model	a	SE	b	SE	adj. var	auto	AICc	a	SE	b	SE	adj. var	auto	AICc
Rand-Walk	0.38	0.12	n/a	n/a	1.93	0.02	74.6	0.38	0.10	n/a	n/a	1.18	-0.25	66.1
Const. Rec	32	10	n/a	n/a	n/a	n/a	75.6	32	9	n/a	n/a	n/a	n/a	70.4
Bev-Holt	1.15	0.73	70	34	1.38	0.04	70.8	1.00	0.51	80	37	0.88	-0.10	61.8
Hock-Stk	0.83	0.40	63	36	1.43	0.04	71.4	0.69	0.23	86	39	1.01	-0.06	64.5
Ricker	0.78	0.29	0.00401	0.00143	1.38	0.04	70.8	0.68	0.20	0.00321	0.00116	0.90	-0.13	62.4

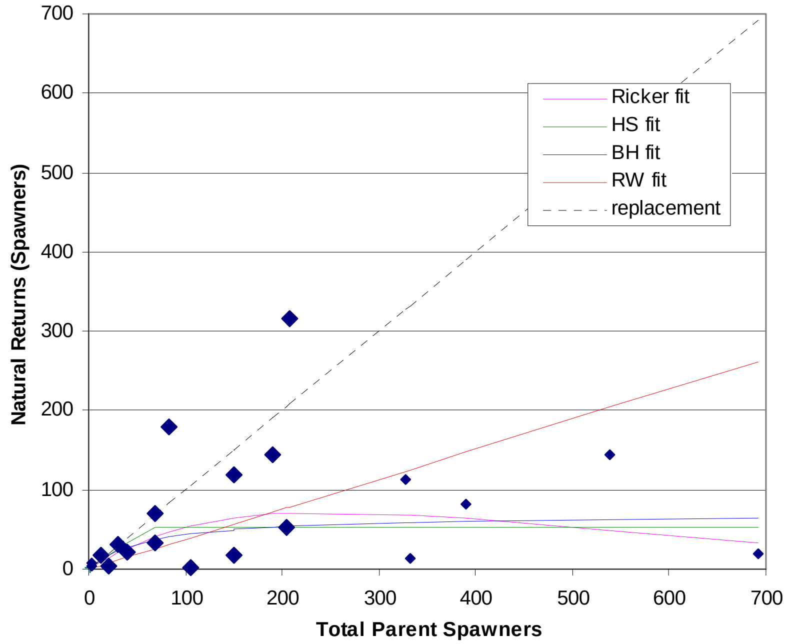

Figure 8. Upper Grande Ronde River Spring Chinook Salmon population stock recruitment curves. Bold points were used in estimating the current productivity. Data were not adjusted for marine survival.

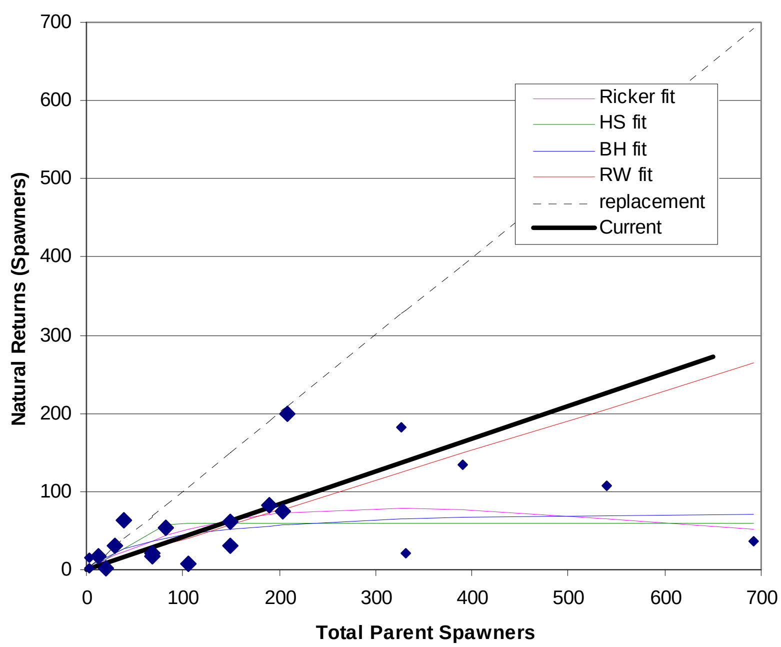

Figure 9. Upper Grande Ronde River Spring Chinook Salmon population stock recruitment curves. Bold points were used in estimating the current productivity. Data were adjusted for marine survival.